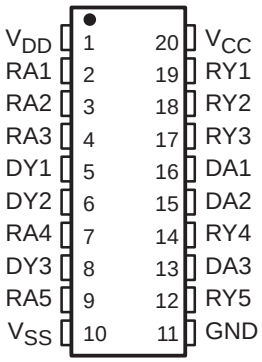
SLLS065F – AUGUST 1989 – REVISED JANUARY 2000

- **Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU Recommendation V.28**
- **Single Chip With Easy Interface Between UART and Serial-Port Connector**
- **Less Than 9-mW Power Consumption**
- **Wide Driver Supply Voltage . . . 4.5 V to 13.2 V**
- **Driver Output Slew Rate Limited to 30 V/μs Max**
- **Receiver Input Hysteresis . . . 1100 mV Typ**
- **Push-Pull Receiver Outputs**
- **On-Chip Receiver 1-μs Noise Filter**
- **Functionally Interchangeable With Texas Instruments SN75185**
- **Operates Up to 120 kbit/s Over a 3-Meter Cable (See *Application Information* for Conditions)**

**DW OR N PACKAGE**
**(TOP VIEW)**



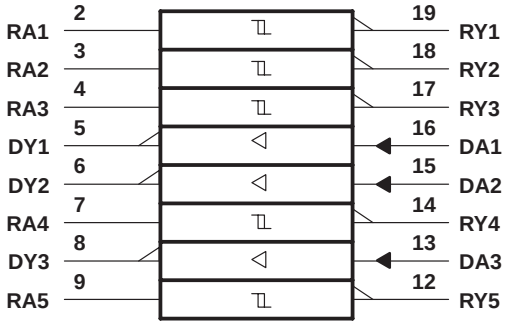

## description

The SN75C185 is a low-power BiMOS device containing three independent drivers and five receivers that are used to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE). Typically, the SN75C185 replaces one SN75188 and two SN75189 devices. This device conforms to TIA/EIA-232-F. The drivers and receivers of the SN75C185 are similar to those of the SN75C188 and SN75C189A, respectively. The drivers have a controlled output slew rate that is limited to a maximum of 30 V/μs, and the receivers have filters that reject input noise pulses that are shorter than 1 μs. Both these features eliminate the need for external components.

The SN75C185 uses the low-power BiMOS technology. In most applications, the receivers contained in this device interface to single inputs of peripheral devices such as ACEs, UARTS, or microprocessors. By using sampling, such peripheral devices usually are insensitive to the transition times of the input signals. If this is not the case, or for other uses, it is recommended that the SN75C185 receiver outputs be buffered by single Schmitt input gates or single gates of the HCMOS, ALS, or 74F logic families.

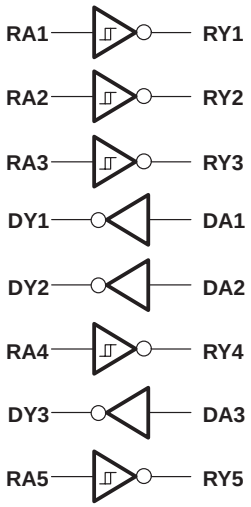
The SN75C185 is characterized for operation from 0°C to 70°C.

## logic symbol†

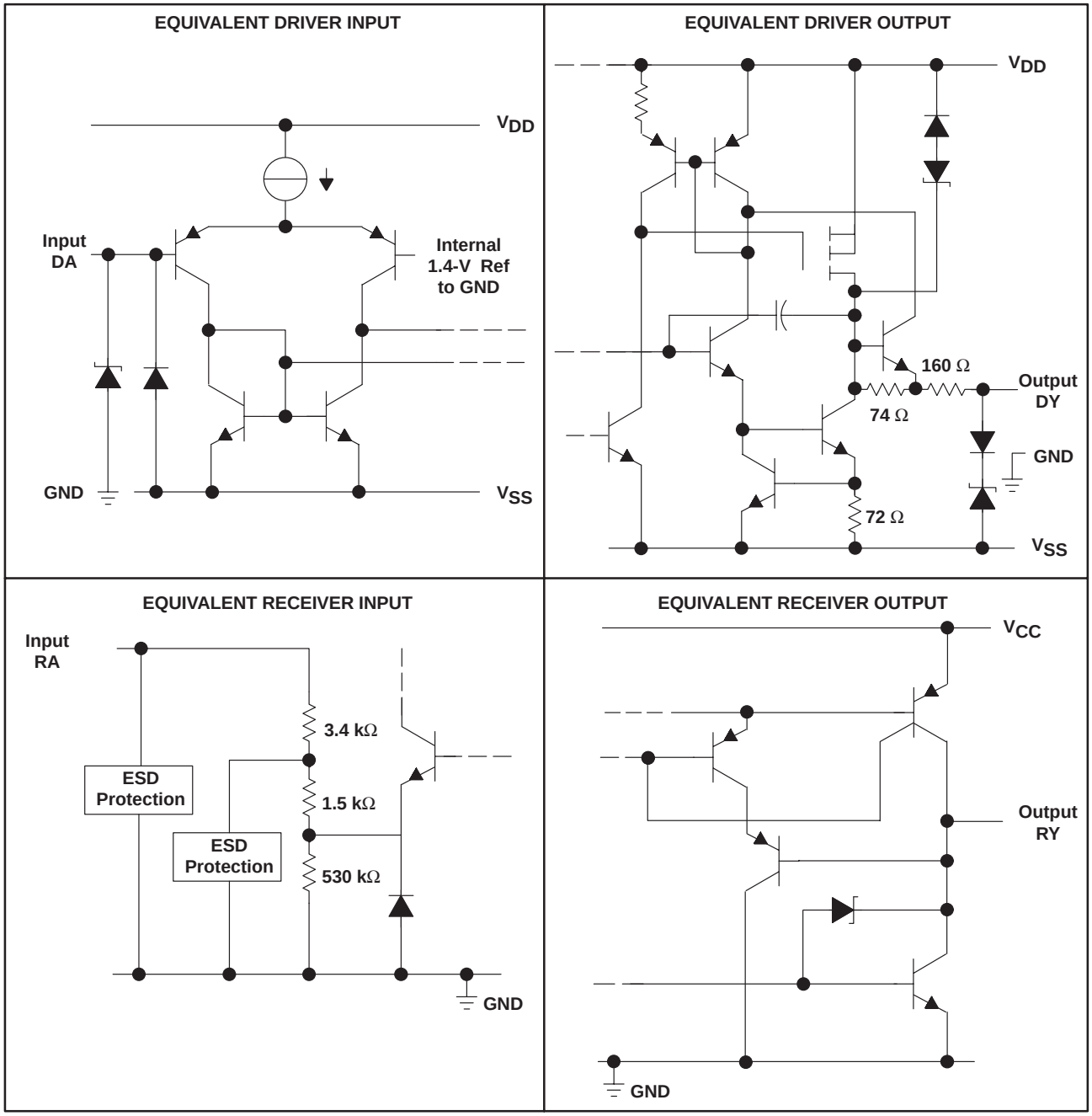



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

## logic diagram (positive logic)



## equivalent schematics of inputs and outputs




All resistor values are nominal.

### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, $V_{DD}$ (see Note 1) . . . . . 13.5 V
Supply voltage, $V_{SS}$ . . . . . –13.5 V
Supply voltage, $V_{CC}$ . . . . . 7 V
Input voltage range, $V_I$: Driver . . . . . $V_{SS}$ to $V_{DD}$
Receiver . . . . . –30 V to 30 V
Output voltage range, $V_O$: Driver . . . . . $V_{SS}$ – 6 V to $V_{DD}$ + 6 V
Receiver . . . . . –0.3 V to $V_{CC}$ + 0.3 V
Package thermal impedance, $\theta_{JA}$ (see Note 2): DW package . . . . . 58°C/W
N package . . . . . 69°C/W
Operating free-air temperature range, $T_A$ . . . . . 0°C to 70°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C
Storage temperature range, $T_{stg}$ . . . . . –65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltages are with respect to network GND.
2. The package thermal impedance is calculated in accordance with JESD 51.

### recommended operating conditions

| | | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|---|
| | Supply voltage | $V_{DD}$ | 4.5 | 12 | 13.2 | V |
| | | $V_{SS}$ | –4.5 | –12 | –13.2 | V |
| | | $V_{CC}$ | 4.5 | 5 | 6 | V |
| $V_I$ | Input voltage (see Note 3) | Drivers | $V_{SS}$+2 | | $V_{DD}$ | V |
| | | Receivers | –25 | | 25 | |
| $V_{IH}$ | High-level input voltage | Drivers | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | | 0.8 | V |
| $I_{OH}$ | High-level output current | Receivers | | | –1 | mA |
| $I_{OL}$ | High-level output current | | | | 3.2 | mA |
| $T_A$ | Operating free-air temperature | | 0 | | 70 | °C |

NOTE 3: The algebraic convention, where the more positive (less negative) limit is designated as maximum, is used in this data sheet for logic levels only, e.g., if –10 V is a maximum, the typical value is a more negative voltage.

### supply currents

| PARAMETER | | TEST CONDITIONS | | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $I_{DD}$ | Supply current from $V_{DD}$ | No load, All inputs at 2 V or 0.8 V | $V_{DD}$ = 5 V, | $V_{SS}$ = –5 V | | 115 | 200 | µA |
| | | | $V_{DD}$ = 12 V, | $V_{SS}$ = –12 V | | 115 | 200 | |
| $I_{SS}$ | Supply current from $V_{SS}$ | No load, All inputs at 2 V or 0.8 V | $V_{DD}$ = 5 V, | $V_{SS}$ = –5 V | | –115 | –200 | µA |
| | | | $V_{DD}$ = 12 V, | $V_{SS}$ = –12 V | | –115 | –200 | |
| $I_{CC}$ | Supply current from $V_{CC}$ | No load All inputs at 0 or 5 V | $V_{DD}$ = 5 V, | $V_{SS}$ = –5 V | | | 750 | µA |
| | | | $V_{DD}$ = 12 V, | $V_{SS}$ = –12 V | | | 750 | |

## DRIVER SECTION

### electrical characteristics over operating free-air temperature range, $V_{DD}$ = 12 V, $V_{SS}$ = –12 V, $V_{CC}$ = 5 V ±10% (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | | MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | $V_{IL}$ = 0.8 V, See Figure 1 | $R_L$ = 3 kΩ, | $V_{DD}$ = 5 V, $V_{SS}$ = –5 V | 4 | 4.5 | | V |
| | | | | $V_{DD}$ = 12 V $V_{SS}$ = –12 V | 10 | 10.8 | | |
| $V_{OL}$ | Low-level output voltage (see Note 3) | $V_{IH}$ = 0.8 V, See Figure 1 | $R_L$ = 3 kΩ, | $V_{DD}$ = 5 V, $V_{SS}$ = –5 V | | –4.4 | –4 | V |
| | | | | $V_{DD}$ = 12 V $V_{SS}$ = –12 V | | –10.7 | –10 | |
| $I_{IH}$ | High-level input current | $V_I$ = 5 V, | See Figure 2 | | | | 1 | µA |
| $I_{IL}$ | Low-level input current | $V_I$ = 0, | See Figure 2 | | | | –1 | µA |
| $I_{OS(H)}$ | High-level short-circuit output current (see Note 4) | $V_I$ = 0.8 V, See FIgure 1 | $V_O$ = 0 or $V_O$ = $V_{SS}$, | | –4.5 | –12 | –19.5 | mA |
| $I_{OS(L)}$ | Low-level short-circuit output current (see Note 4) | $V_I$ = 2 V, See Figure 1 | $V_O$ = 0 or $V_O$ = $V_{DD}$, | | 4.5 | 12 | 19.5 | mA |
| $r_o$ | Output resistance | $V_{DD}$ = $V_{SS}$ = $V_{CC}$ = 0, See Note 5 | $V_O$ = – 2 V to 2 V, | | 300 | 400 | | Ω |

† All typical values are at $T_A$ = 25°C.

NOTES: 3. The algebraic convention, where the more positive (less negative) limit is designated as maximum, is used in this data sheet for logic levels only, e.g., if –10 V is a maximum, the typical value is a more negative voltage.
4. Not more than one output should be shorted at one time.
5. Test conditions are those specified by TIA/EIA-232-F.

### switching characteristics, $V_{DD}$ = 12 V, $V_{SS}$ = –12 V, $V_{CC}$ = 5 V ±10%, $T_A$ = 25°C (unless otherwise noted) (see Figure 3)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time, low- to high-level output (see Note 6) | $R_L$ = 3 kΩ to 7 kΩ, | $C_L$ = 15 pF | | 1.2 | 3 | µs |
| $t_{PHL}$ | Propagation delay time, high- to low-level output (see Note 6) | | | | 2.5 | 3.5 | µs |
| $t_{TLH}$ | Transition time, low- to high-level output | | | 0.53 | 2 | 3.2 | µs |
| $t_{THL}$ | Transition time, high- to low-level output | | | 0.53 | 2 | 3.2 | µs |
| $t_{TLH}$ | Transition time, low- to high-level output (see Note 7) | $R_L$ = 3 kΩ to 7 kΩ, | $C_L$ = 2500 pF | | 1 | | µs |
| $t_{THL}$ | Transition time, high- to low-level output (see Note 7) | | | | 1 | | µs |
| $S_R$ | Output slew rate (see Note 7) | $R_L$ = 3 kΩ to 7 kΩ, | $C_L$ = 15 pF | 4 | 10 | 30 | V/µs |

NOTES: 6. $t_{PHL}$ and $t_{PLH}$ include the additional time due to on-chip slew rate and are measured at the 50% points.
7. Measured between 3-V and –3-V points of output waveform TIA/EIA-232-F conditions), and all unused inputs are tied either high or low.

## RECEIVER SECTION

### electrical characteristics over operating free-air temperature range, $V_{DD}$ = 12 V, $V_{SS}$ = −12 V, $V_{CC}$ = 5 V ±10% (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | | MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IT+}$ | Positive-going input threshhold voltage | See Figure 5 | | | 1.6 | 2.1 | 2.55 | V |
| $V_{IT-}$ | Negative-going input threshhold voltage | See Figure 5 | | | 0.65 | 1 | 1.25 | V |
| $V_{hys}$ | Input hysteresis voltage ($V_{IT+} - V_{IT-}$) | | | | 600 | 1100 | | mV |
| $V_{OH}$ | High-level output voltage | $V_I$ = 0.75 V, | $I_{OH}$ = −20 µA, | See Figure 5 and Note 8 | 3.5 | | | V |
| | | $V_I$ = 0.75 V, $I_{OH}$ = −1 mA, See Figure 5 | $V_{CC}$ = 4.5 V | | 2.8 | 4.4 | | |
| | | | $V_{CC}$ = 5 V | | 3.8 | 4.9 | | |
| | | | $V_{CC}$ = 5.5 V | | 4.3 | 5.4 | | |
| $V_{OL}$ | Low-level output voltage | $V_I$ = 3 V, | $I_{OL}$ = 3.2 mA, | See Figure 5 | | 0.17 | 0.4 | V |
| $I_{IH}$ | High-level input current | $V_I$ = 3 V | | | 0.43 | 0.55 | 1 | mA |
| | | $V_I$ = 25 V | | | 3.6 | 4.6 | 8.3 | |
| $I_{IL}$ | Low-level input current | $V_I$ = −3 V | | | −0.43 | −0.55 | −1 | mA |
| | | $V_I$ = −25 V | | | −3.6 | −5.0 | −8.3 | |
| $I_{OS(H)}$ | Short-circuit output at high level | $V_I$ = 0.75 V, | $V_O$ = 0, | See Figure 4 | | −8 | −15 | mA |
| $I_{OS(L)}$ | Short-circuit output at low level | $V_I$ = $V_{CC}$, | $V_O$ = $V_{CC}$, | See Figure 4 | | 13 | 25 | mA |

† All typical values are at $T_A$ = 25°C.

NOTE 8: If the inputs are left unconnected, the receiver interprets this as an input low, and the receiver outputs remain in the high state.

### switching characteristics, $V_{DD}$ = 12 V, $V_{SS}$ = −12 V, $V_{CC}$ = 5 V ±10%, $T_A$ = 25°C (unless otherwise noted) (see Figure 6)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time, low- to high-level output | $R_L$ = 5 kΩ, | $C_L$ = 50 pF | | 3 | 4 | µs |
| $t_{PHL}$ | Propagation delay time, high- to low-level output | | | | 3 | 4 | µs |
| $t_{TLH}$ | Transition time, low- to high-level output | | | | 300 | 450 | ns |
| $t_{THL}$ | Transition time, high- to low-level output | | | | 100 | 300 | ns |
| $t_{w(N)}$ | Duration of longest pulse rejected as noise (see Note 9) | $R_L$ = 5 kΩ, | $C_L$ = 50 pF | 1 | | 4 | µs |

NOTE 9: The receiver ignores any postive- or negative-going pulse that is less than the minimum value of $t_{w(N)}$ and accepts any positive- or negative-going pulse greater than the maximum of $t_{w(N)}$.

## PARAMETER MEASUREMENT INFORMATION

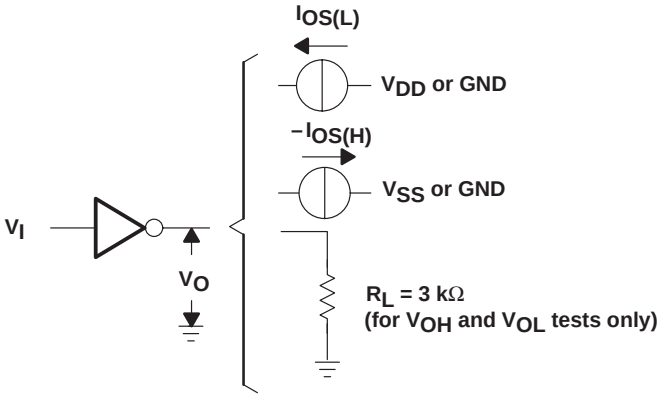



**Figure 1. Driver Test Circuit for $V_{OH}$, $V_{OL}$, $I_{OS(H)}$, and $I_{OS(L)}$**

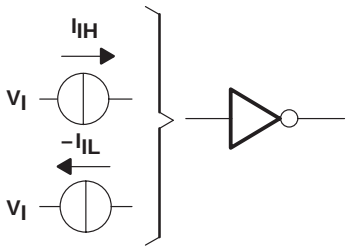
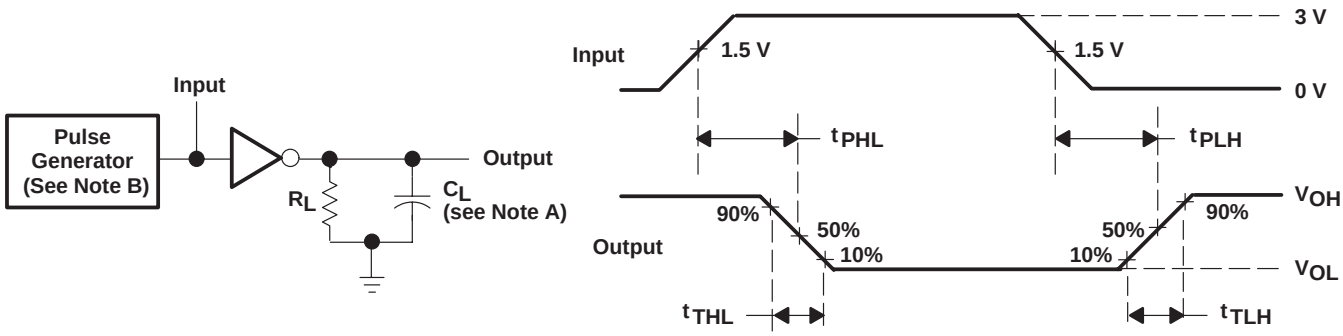



**Figure 2. Driver Test Circuit for $I_{IH}$ and $I_{IL}$**




NOTES: A. $C_L$ includes probe and jig capacitance.
B. The pulse generator has the following characteristics: $t_W$ = 25 μs, PRR = 20 kHz, $Z_O$ = 50 Ω, $t_r = t_f$ < 50 ns.

**Figure 3. Driver Test Circuit and Voltage Waveforms**

## PARAMETER MEASUREMENT INFORMATION

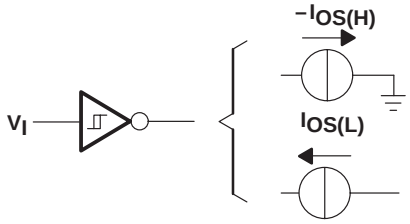



**Figure 4. Receiver Test Circuit for $I_{OS(H)}$ and $I_{OS(L)}$**

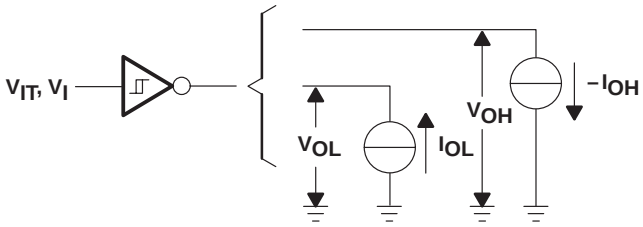
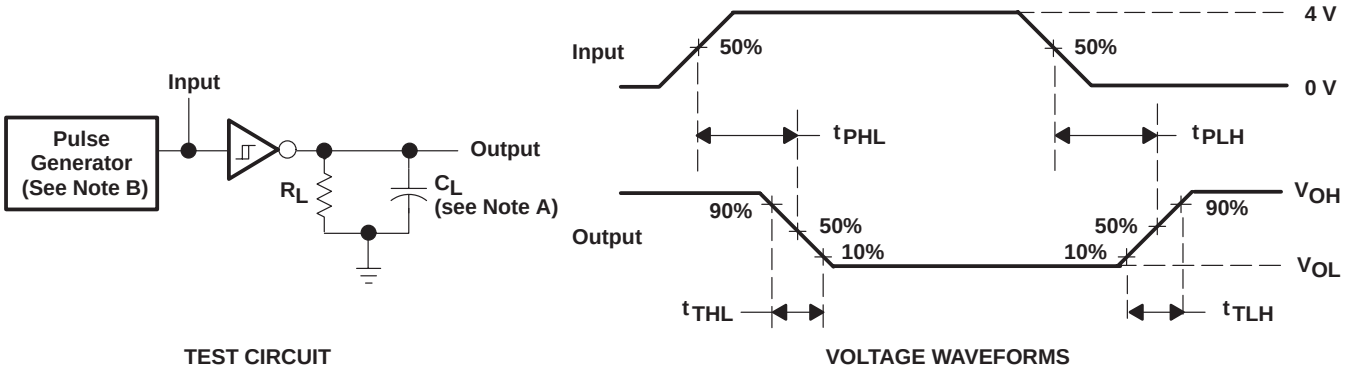



**Figure 5. Receiver Test Circuit for $V_{IT}$, $V_{OH}$, and $V_{OL}$**




NOTES: A. $C_L$ includes probe and jig capacitance.
B. The pulse generator has the following characteristics: $t_w$ = 25 µs, PRR = 20 kHz, $Z_O$ = 50 Ω, $t_r = t_f$ < 50 ns.

**Figure 6. Receiver Propagation and Transition Times**

## APPLICATION INFORMATION

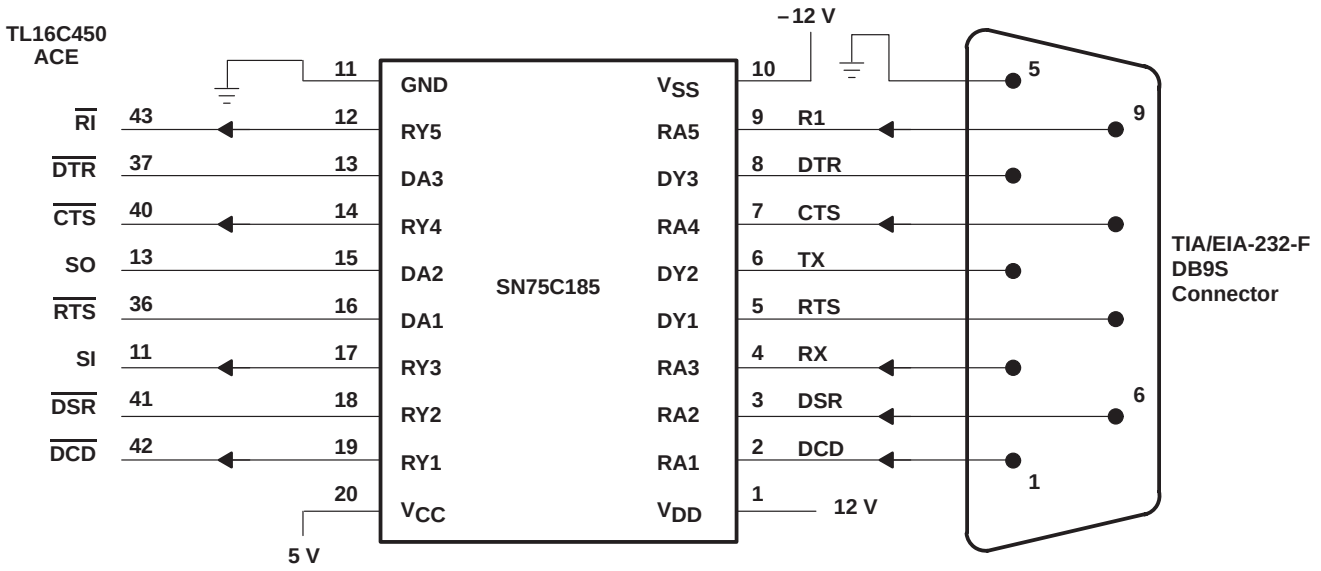
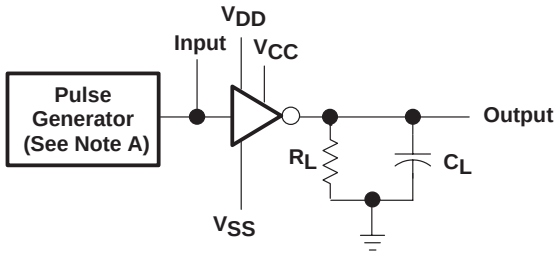



**Figure 7. Typical Connection**

The SN75C185 supports data rates up to 120 kbit/s over a 3-meter cable. Laboratory experiments show that, with $C_L$ = 500 pF and $R_L$ = 3 kΩ (minimum RS-232 input resistance load), the device can support this data rate. The 500-pF load approximates a typical 3-meter cable because the maximum RS-232 specification is 2500 pF (or about 15 meters). Figure 8 shows the test circuit used. Temperature was varied from 0°C to 70°C for the experiment.




NOTES: A. The pulse generator has the following characteristics: PRR = 60 kHz (120 kbit/s), $Z_O$ = 50 Ω.
B. $V_{CC}$ = 5 V, $V_{DD}$ = 12 V, $V_{SS}$ = –12 V.

**Figure 8. Data-Rate Test Circuit**

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SN75C185DW | ACTIVE | SOIC | DW | 20 | 25 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | 0 to 70 | SN75C185 | Samples |
| SN75C185DWG4 | ACTIVE | SOIC | DW | 20 | 25 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | 0 to 70 | SN75C185 | Samples |
| SN75C185DWR | ACTIVE | SOIC | DW | 20 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | 0 to 70 | SN75C185 | Samples |
| SN75C185N | ACTIVE | PDIP | N | 20 | 20 | RoHS & Green | NIPDAU | N / A for Pkg Type | 0 to 70 | SN75C185N | Samples |
| SN75C185NE4 | ACTIVE | PDIP | N | 20 | 20 | RoHS & Green | NIPDAU | N / A for Pkg Type | 0 to 70 | SN75C185N | Samples |

(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

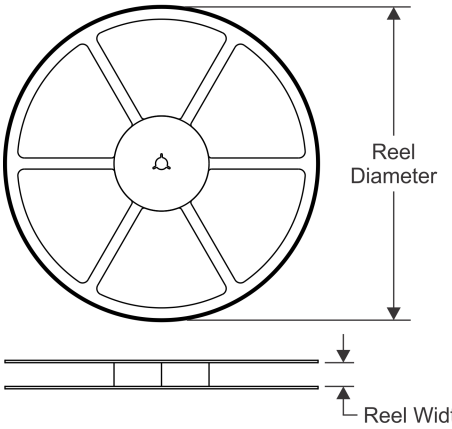
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

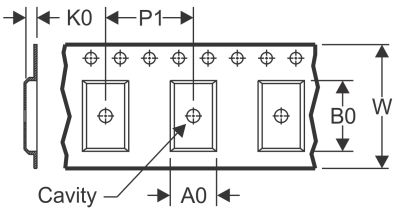
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

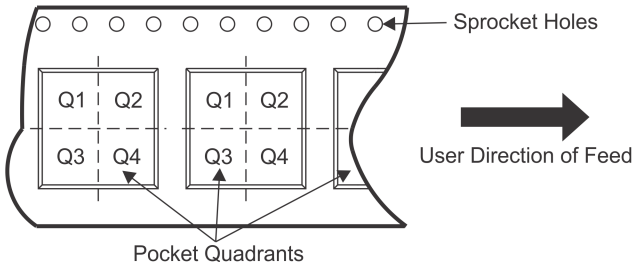



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

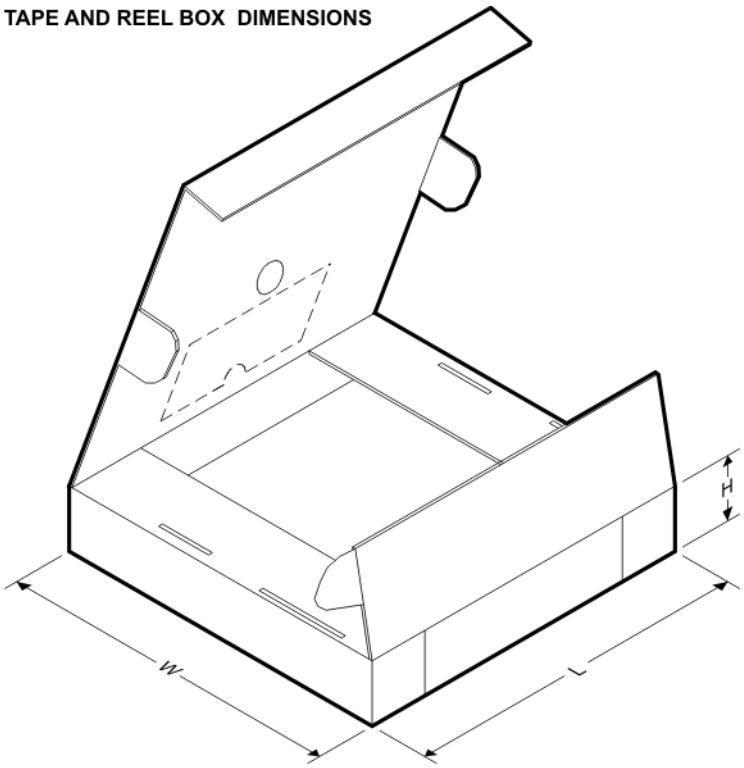
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN75C185DWR | SOIC | DW | 20 | 2000 | 330.0 | 24.4 | 10.8 | 13.3 | 2.7 | 12.0 | 24.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



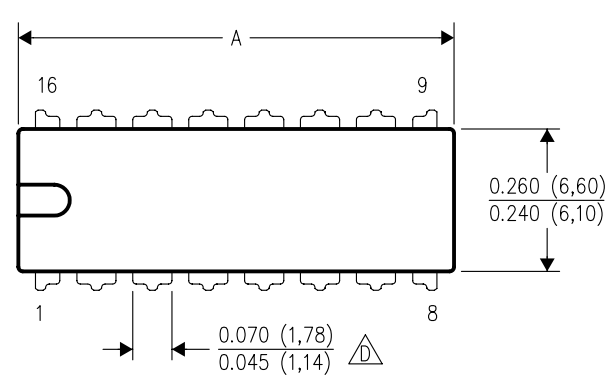

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| SN75C185DWR | SOIC | DW | 20 | 2000 | 350.0 | 350.0 | 43.0 |

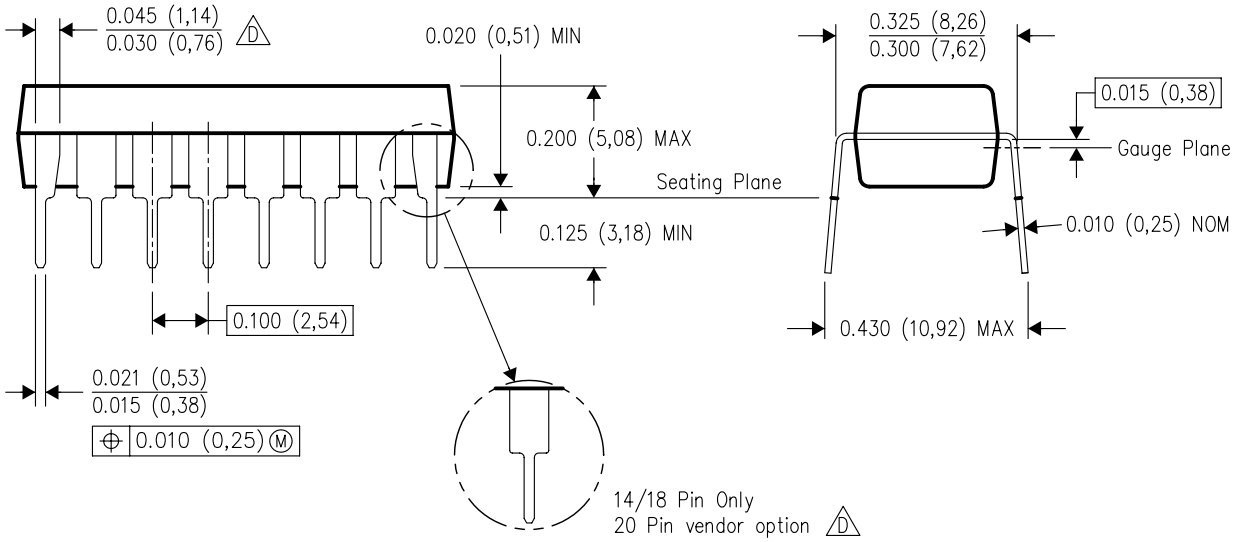
## N (R–PDIP–T**)

## PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN

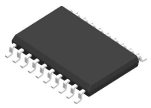



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS–001 VARIATION (C) | AA | BB | AC | AD |




4040049/E 12/2002

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

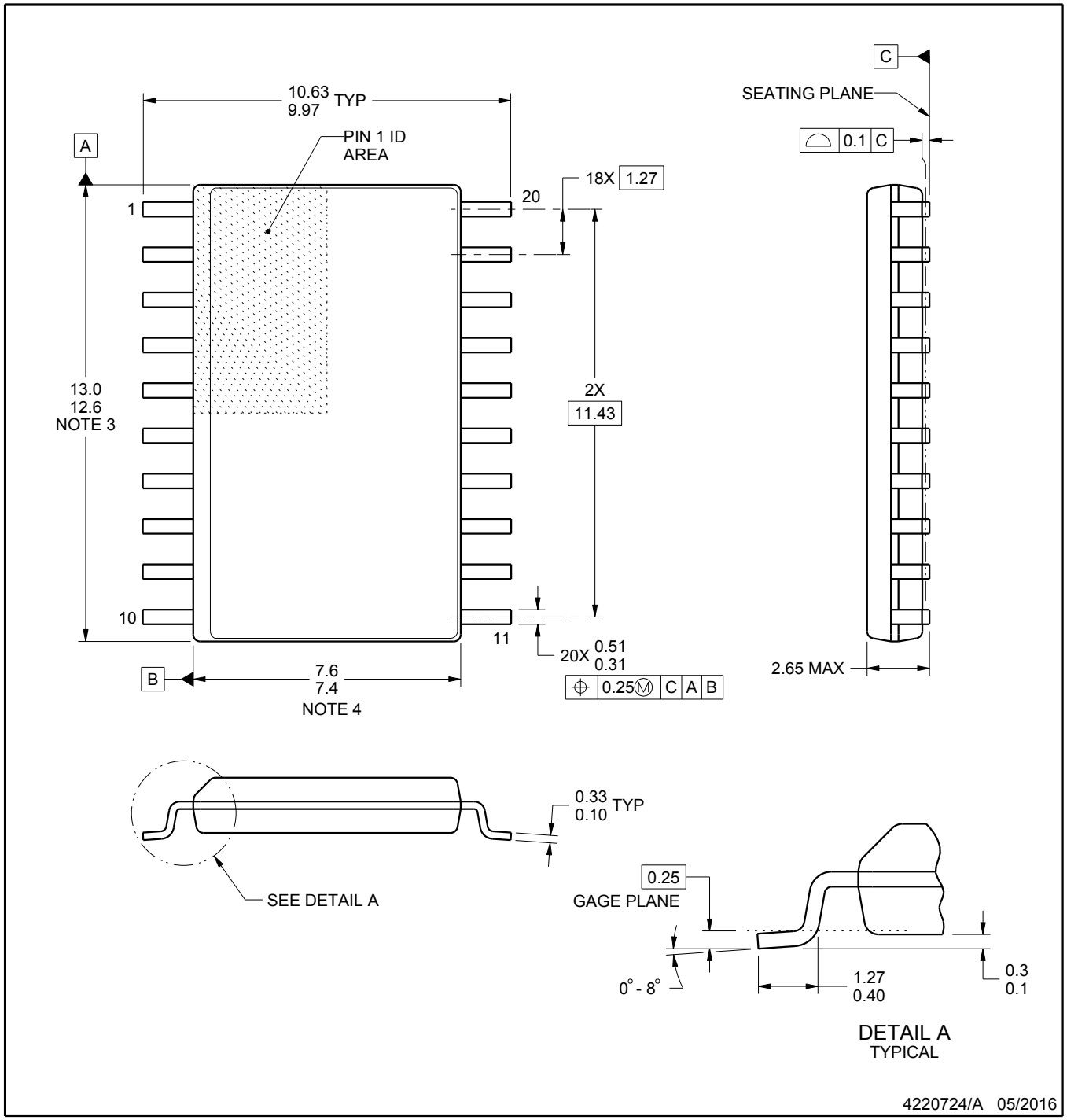


# PACKAGE OUTLINE

## DW0020A

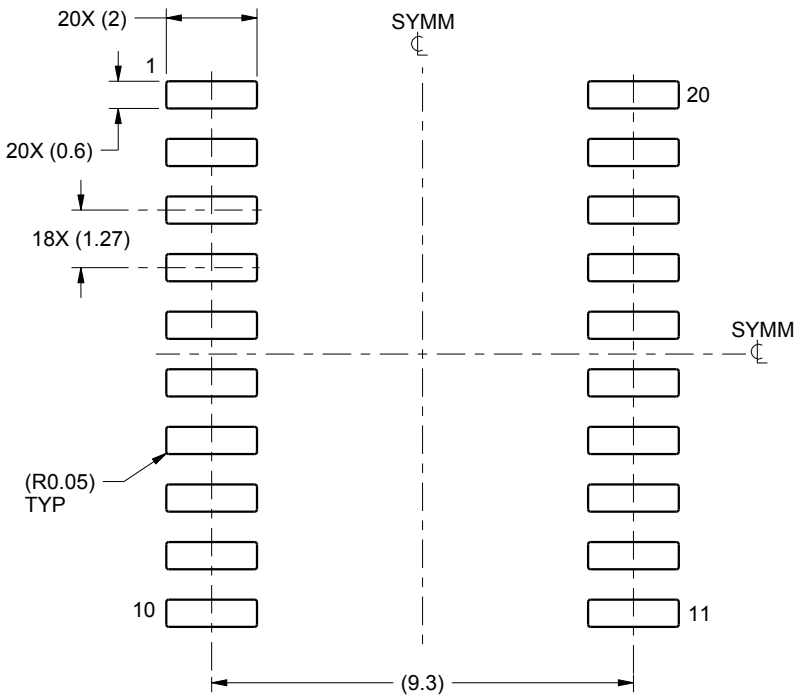
## SOIC - 2.65 mm max height

SOIC

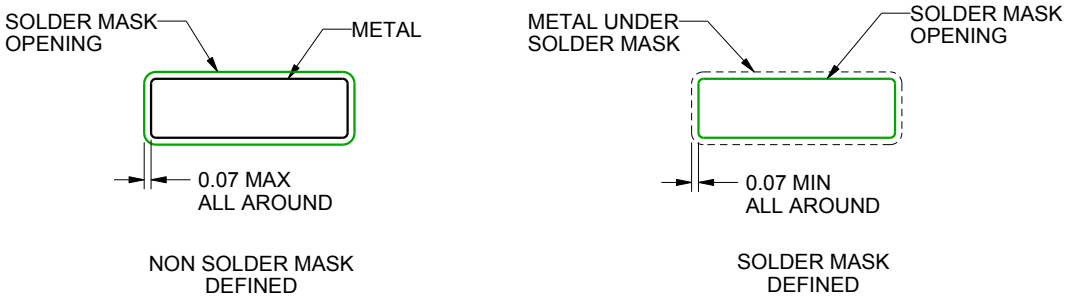



NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.




LAND PATTERN EXAMPLE
SCALE:6X

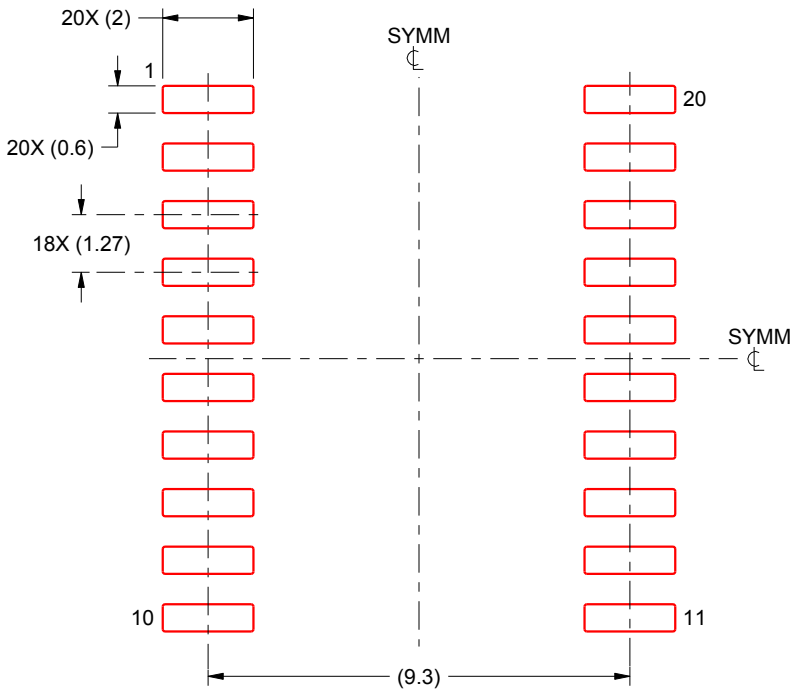



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.




SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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